ATMOSPHERIC ELECTRICITY.

AURORAS.

The most brilliant and extensively observed aurora of the month was that which appeared on the night of the 19–20th; it was visible, except in the lower lake region, from Eastport, Maine, to Fort Buford, Dakota, and as far south as the fortieth parallel. The sky in the lower lake region was generally obscured by clouds, but several stations in that district report auroral lights as being visible for a few seconds through breaks in the clouds. An aurora of moderate intensity was observed on the night of the 12–13th in New England and the upper lake region; it was also faintly visible in southern Ohio, southern Indiana, and northern Dakota. This display was probably as extensive as that of the 19th, and was also reported from a number of stations between Eastport, Maine, and Fort Buford, Dakota, but, owing to cloudy weather, was not seen at stations in New York, Pennsylvania, the lower lake region, and the upper part of the Mississippi and Missouri valleys. On the night of the 13–14th an aurora was reported from a number of stations in New England, New York, and northern Michigan; it was not reported from other sections of the eastern part of the United States, although clear weather prevailed east of the Mississippi River and north of Tennessee and North Carolina.

The following is a short statement of the weather conditions attending the more important of the remaining displays of the month. On the night of the 11–12th an aurora was visible at Nashua, New Hampshire, Woodstock, Maryland, and at stations in the northern part of Minnesota, Dakota, and Montana; the sky on the night of the 11–12th was cloudy in New England, the middle Atlantic states, and the lower lake region, and clear from that district westward to Montana. A faint aurora was seen on the 16th at two stations in New England, and at a few scattering stations in the extreme northern districts; clear weather prevailed, except in New England. An aurora was visible on the night of the 21st–22d at stations in the northern part of New England, Michigan, Minnesota, and Dakota; in these districts the sky was clear; in the remainder of the northeastern quarter of the country the sky was overcast. On the night of the 2–3d an aurora was visible at Franklin, Wisconsin; on that date cloudy weather, with rain or snow, prevailed over the greater part of the eastern districts of the country.

The following are descriptions of the more important displays, as observed from different places:

Rochester, New York: at 9.50 p. m. of the 11th, while light snow was falling, an aurora, in the form of an arch of light extending from east to west through the northern half of the sky, was seen. The display was obscured by clouds at 10.07 p. m.

Cambridge, Middlesex county, Massachusetts: on the 12th a double auroral arch was visible from 7 to 11 p. m.; a few faint streamers were seen. On the 13th a faint auroral light, with some appearance of streamers, became visible at 9 p. m. and had not all disappeared at 11.30 p. m. Auroral lights were also visible on the 14th, 19th, and 25th.

Amherst, Hampshire county, Massachusetts: an aurora was visible at different times during the evening of the 12th, at intervals rapidly changing streamers were visible, shooting up to an altitude of 30°. An auroral light was also visible during the night of the 13–14th. At 8.30 p. m. very brilliant streamers, extending to an altitude of 20°, appeared.

Eastport, Maine: an auroral arch was visible from 7 to 9 p. m. of the 12th; on the 13th a faint auroral light appeared at 8. p. m. and remained visible until midnight. Faint auroral displays were observed on the 17th from 10 to 11 p. m., and on the 19th from 9 p. m. until after midnight.

Escanaba, Michigan: faint auroral lights were seen on the nights of the 12–13th and 13–14th. On the night of the 19–20th an aurora of moderate brilliancy was visible from 8.30 p. m. until 3.30 a. m., when it became obscured by clouds; the display appeared in the form of a luminous arch rising over a dark segment; altitude, 12°; azimuth, 160° to 200°. At midnight it increased in brilliancy, and straw-colored streamers shot up to an altitude of about 30°. An auroral display was also observed on the night of the 20th–21st from 8 p. m. until 2 a. m.

Fort Buford, Dakota: an aurora was visible from 10.28 to 11.30 p. m. of the 12th; it consisted of an imperfect arch extending from northwest to northeast and to an altitude of about 15°. On the 19th an aurora of a pale white color, and having the appearance of an illuminated cloud, was visible from 9.33 to 11.30 p. m., when it became obscured by clouds.

Buffalo, New York: at 6.50 p. m. of the 12th a white auroral arch became visible, having an altitude of 9°. The display gradually increased in altitude until at 7.25 p. m. it had attained its maximum, 25°, with an azimuth of 110° to 120°. At 7.33 p. m. the arch began to waver and grow dimmer on its eastern side and shortly after entirely disappeared. The display was quite brilliant and attracted considerable attention.

Oswego, New York: on the 19th, at 9.45 p. m., a faint auroral light was observed through breaks in the clouds that nearly covered the sky. The light was completely hidden from view by clouds at 10.45 p. m., but was visible at intervals between midnight and 1.30 a. m. of the 20th.

Dover, Morris county, New Jersey: an auroral display was visible on the 19th between 9 and 10 p. m.; it consisted of a very bright light, extending to altitude 15°, and 35° east and 15° west of north.

Bismarck, Dakota: an auroral light was seen at 11.15 p. m. of the 19th; the display attained its maximum at 12.30 a. m. of the 20th. At that time it consisted of a bright yellow light, extending from azimuth 125° to 235°, altitude 60°. At 4 a. m. the light was covered by clouds.

Saint Vincent, Minnesota: at 9 p. m. of the 19th an auroral light became visible in the northern sky. When first observed it had the form of an undulating ribbon of yellowish light of about 3° altitude and 90° azimuth. The aurora remained in this form about half an hour, after which a few faint beams of light ascended toward the zenith; these gradually increased in number and brightness, the larger ones showing a combination of brilliant colors, varying from a deep orange yellow at the base to green at the tips. At the time of greatest brilliancy distinct shadows of buildings or other objects were cast on the snow. The display ended during the early morning of the 20th.

Marquette, Michigan: an aurora was visible from 8.20 to 11.30 p. m. of the 19th. When first observed it consisted of an arch extending from azimuth 80° to 180°; at 9.30 p. m. a second arch made its appearance, and shortly after a few bright streamers shot upward to a height of about 50°. The aurora began fading at 10.30 p. m., and at 11.30 p. m. had entirely disappeared. The observer at this place states that on the night of the 20th–21st an aurora was observed that was almost a counterpart of that of the previous night. It was visible from 8.30 p. m. until after midnight.

Poplar River, Montana: auroral lights were visible in the northern sky on the 10th from 10.30 to 11.50 p. m.; on the 11th from 10.30 p. m. until the early morning of the 12th; during the morning of the 13th from 12.10 until 4 a. m.; in the early morning and after sunset of the 14th until 4 a. m. of the 15th; on the 16th from 1 to 4 a. m.; at 9 p. m. of the 20th; from 2 to 4 a. m. of the 22d. On the 23d the aurora appeared in the form of an arch of yellow light, with streamers shooting up to an altitude of 15°; the display was visible from 12.30 to 5 a. m.

The above displays were also observed at the following places:

2d.—Franklin, Wisconsin.

4th.—Bethel, Connecticut.

11th.—Fort Totten and Webster, Dakota; Woodstock, Maryland; Duluth, Minnesota; Nashua, New Hampshire.

12th.—Voluntown, Connecticut; Butlerville, Indiana; Cornish and Gardiner, Maine; Boston, Amherst, Blue Hill Observatory, Dudley, Fall River, Milton, North Truro, Somerset, and Westborough, Massachusetts; Alpena, Mackinaw City, Swartz Creek, and Traverse City, Michigan; Nashua, New Hampshire;

Moorestown, New Jersey; Le Roy, New York; College Hill, Ohio; Lunenburg, Newport, and Strafford, Vermont; Madison and Prairie du Chien, Wisconsin.

13th.—Southington, Connecticut; Cornish, Gardiner, and Orono, Maine; Amherst, Blue Hill Observatory, Fall River, Milton, and North Truro, Massachusetts; Mackinaw City, Michigan; Berlin Mills, New Hampshire; Factoryville and Palermo, New York; Lunenburg, Post Mills, Newport, Strafford, and Brattleborough, Vermont.

14th.—Fort Totten, Dakota; Cornish, Gardiner, and Orono, Maine; Blue Hill Observatory, Fall River, and North Truro, Massachusetts.

15th.—Cresco, Iowa.

16th.—Fort Totten and Webster, Dakota; Mackinaw City, Michigan; Newport and Brattleborough, Vermont.

18th—Fort Madison, Iowa.

19th.—Bethel, Southington, and Voluntown, Connecticut; Parkston, Bismarck, Webster, and Fort Totten, Dakota; Riley, Illinois; Cresco, Fort Madison, and Monticello, Iowa; Cornish and Gardiner, Maine; Boston, Vineyard Haven, Blue Hill Observatory, Dudley, Fall River, North Truro, and Somerset, Massachusetts; Alpena, Michigan; Duluth and Moorhead, Minnesota; Nashua, New Hampshire; Setauket, New York; Sandusky, Napoleon, and Wauseon, Ohio; Block Island, Rhode Island; Lunenburg and Brattleborough, Vermont; Manitowoc, Wisconsin.

20th.—Fort Totten and Webster, Dakota; Traverse City, Michigan; Block Island, Rhode Island.

21st.—Fort Totten, Dakota; Gardiner, Maine; Marquette, Michigan; Duluth, Minnesota.

22d.—Mackinaw City, Michigan.

23d.—Fort Totten, Dakota; Lunenburg, Vermont.

24th.—Manitowoc, Wisconsin.

25th.—Fort Totten, Dakota; Cornish, Maine; Nashua, New Hampshire.

26th.—Lunenburg, Vermont.

28th.—Pekin, Illinois.

THUNDER-STORMS.

Paterson, Passaic county, New Jersey: a very heavy thunder-storm from the southwest occurred on the afternoon of the 18th. The thunder was loud and the lightning vivid and constant, several houses and barns were struck and burned. This was an unusually destructive storm for this season of the year. It was more severe at Moorestown than any other winter thunder-storm of the past twenty-three years, the electrical discharges were almost constant and the thunder very violent. The storm continued two hours; 1.54 inches of rain fell, washing fields badly.

Dover, Morris county, New Jersey: on the 18th strong easterly wind and snow prevailed between 6 and 8 a. m., this was followed by heavy rain during the remainder of the day. At 6 p. m. a thunder-storm set in and continued for an hour, the lightning was vivid and almost continuous, the thunder sharp and loud.

Somerset, Bristol county, Massachusetts: the atmospherical disturbance of the 18th and 19th was, in this vicinity, a succession of thunder-storms. The lightning was sharp and frequent and the thunder heavy and rolling.

New York City: the 18th was warm for the season, with heavy showers of rain at times. From 6.15 to 9.25 p. m. the rain was accompanied by thunder, lightning, and high easterly winds; the gale did considerable damage to chimneys and telegraph wires. During the storm a warehouse on Staten Island was struck by lightning and burned, together with several other large buildings and their contents, mostly cotton, entailing a loss of about $350,000.

Laconia, Harrison county, Indiana: the observer at this place states that the most notable feature of the month was the unusually large number of heavy thunder-storms for this season. On the 1st light rain and sleet set in at 4 a. m. and continued throughout the day; between 7 and 8 p. m. the storm was accompanied by vivid lightning and heavy rolling thunder. Thunder was also heard during the night of the 1st–2d, on the afternoon of the 2d, and on the morning of the 3d. On the 26th, at 7 a. m., a strong southwesterly gale, attended by heavy rain, thunder, and lightning, set in, and did considerable damage, prostrating trees, fences, and light buildings.

Thunder-storms were also observed in the various states and territories during the month, as follows:

Alabama.—Livingston, 15th, 18th, 20th, 26th; Mobile and Greensborough, 26th.

Arkansas.—Lead Hill, 2d, 26th; Little Rock, 14th, 17th.

California.—Los Angeles, 14th; Oroville, 21st.

Connecticut.—Bethel and Southington, 18th.

District of Columbia.—Washington City and Kendall Green, 18th.

Florida.—Limona, 15th; Archer, 15th, 18th, 24th, 26th, 27th; Duke, 24th, 26th; Cedar Keys, 24th, 26th, 27th; Tallahassee, 26th.

Georgia.—Athens, 1st, 26th; Savannah, 18th; Atlanta and Milledgeville, 20th, 26th; Forsyth, 20th, 24th, 26th.

Illinois.—Windsor, 1st, 2d, 10th, 11th, 17th, 25th; Mattoon, 1st, 2d, 10th, 17th, 25th; Collinsville, 1st, 2d, 25th, 26th; Springfield, 1st, 17th; Sandwich, 7th, 10th, 17th, 23d; Riley, 8th; Chicago, 8th, 17th; Pekin and Peoria, 10th; Charleston, 10th, 25th, 26th; Geneseo, 17th; South Evanston and Sycamore, 27th, 23d; Cairo, 23d, 25th.

Indiana.—Jeffersonville, 1st, 2d, 17th, 25th, 26th; Vevay, 1st, 3d, 10th, 26th; Lafayette, 1st, 7th; Fort Wayne and Logansport, 1st, 10th; Indianapolis, 1st, 25th, 26th; Sunman, 2d, 3d, 10th, 23d, 25th, 26th; Laconia, 2d, 3d, 26th; Mauzy, 2d, 23d; Butlerville, 2d, 10th, 23d, 26th; La Grange, 8th, 10th.

Indian Territory.—Fort Reno, 10th; Fort Sill, 10th, 19th; Fort Gibson, 25th.

Iowa.—Clinton, 5th, 7th, 17th; Dubuque, 6th; Monticello and Cedar Rapids *a*, 6th, 17th; Cedar Rapids *b*, 7th; Muscatine, 7th, 11th; Dubuque, 7th, 17th; Oskaloosa *a*, 7th, 25th; Keokuk, 8th, 10th, 17th; Fort Madison, 10th, 17th; Oskaloosa *b*, 25th.

Kansas.—Wellington, 7th, 10th; Leavenworth, 8th; Wyandotte, 8th, 10th; Globe, 8th, 10th, 25th; El Dorado and Emporia, 20th.

Kentucky.—Louisville, 1st, 2d, 3d, 17th, 26th; Harpers Ferry, 1st, 2d, 17th, 25th, 26th.

Louisiana.—New Orleans, 20th, 21st, 22d, 25th; Shreveport, 14th, 17th, 19th, 23d; Grand Coteau, 19th, 20th, 21st.

Maryland.—Fort McHenry, 17th; Fallston, New Midway, and Woodstock, 18th.

Massachusetts.—Wood's Holl, Amherst, Cambridge, Deerfield, Dudley, Fall River, Milton, New Bedford, Taunton, Westborough, and Worcester, 18th.

Michigan.—Mottville, 7th, 10th; Grand Haven, 7th, 23d; Kalamazoo, 8th, 23d; Swartz Creek and Thornville, 23d; Lansing, 24th.

Mississippi.—Vicksburg, 18th, 19th, 20th.

Missouri.—Saint Louis, 1st, 2d; Centreville, 1st, 2d, 3d, 25th; Central College, 8th, 10th, 17th; Conception, 9th, 25th; Springfield, 17th, 24th.

Nebraska.—Stockham, 8th.

New Hampshire.—Manchester, Antrim, and Nashua, 18th.

New Jersey.—Beverly, Clayton, Lakewood, Readington, Roseland, and South Orange, 18th.

New York.—Humphrey, 3d; Oswego, 3d, 24th; Brooklyn, Factoryville, Menands, Setauket, and White Plains, 18th; North Volney, Palermo, and Utica, 24th.

North Carolina.—Raleigh, 1st, 26th; Lincolnton, 23d; Kitty Hawk, 27th.

Ohio.—Portsmouth, 1st, 2d, 3d, 25th, 26th; Columbus and Westerville, 2d, 3d; Tiffin, 2d, 3d, 7th, 10th, 14th, 23d; Elyria and Garrettsville, 2d, 3d, 10th, 23d; College Hill, 2d, 3d, 26th; Napoleon, 2d, 7th, 10th; Cleveland *a*, Sandusky, and Toledo, 2d, 10th; Cleveland *b*, 2d, 10th, 23d; Yellow Springs, 2d, 11th, 23d, 25th, 26th; Ruggles, 3d, 7th; Wauseon, 7th, 10th, 18th; Jacksonborough, 10th, 23d, 26th; North Lewisburg, 23d.

Oregon.—Bandon, 23d.

Pennsylvania.—Phillipsburg, 1st, 2d, 3d; State College, 2d, 24th; Grampian Hills, 3d; Pittsburg, 3d, 10th, 18th; Erie, 3d, 11th, 18th; Zionsville, 15th, 26th; Philadelphia, Blooming Grove, Dyberry, and Quakertown, 18th.

Rhode Island.—Narragansett Pier, 18th; Block Island, 18th, 19th.

South Carolina.—Stateburg, 9th, 18th; Spartanburg, 20th, 26th; Charleston, 24th.

Tennessee.—Nashville, 1st, 2d, 3d, 17th, 18th, 23d, 24th, 26th; Milan, 1st, 2d, 3d, 17th, 23d, 26th; Ashwood, 1st, 17th, 23d; Knoxville, 1st, 2d, 24th; Memphis, 2d, 3d, 17th, 23d, 26th; Chattanooga, 23d, 24th, 26th.

Texas.—New Ulm, 2d, 3d, 25th; Silver Falls, 4th, 7th; Fort Davis, 13th; Cleburne, 14th; San Antonio, 17th; Palestine, 19th; Galveston, 26th.

Virginia.—Rappahannock, 9th, 10th, 13th; Bird's Nest, Dale Enterprise, University of Virginia, Variety Mills, and Wytheville, 18th; Bruington, 26th.

West Virginia.—Middlebrook, 1st, 2d, 3d, 10th, 18th; Clarksburg, 2d; Helvetia, 2d, 17th.

Wisconsin.—Madison, 6th; Milwaukee, 7th; Delavan, 7th, 17th.

ELECTROMETER READINGS.

Observations of the electrical potential of the air were made as usual during the month of February, 1887. At Washington City, in addition to the regular series of observations, a set of simultaneous observations were made at the Signal Office, elevation 45 feet, and at the top of the Washington Monument, elevation 500 feet. The following table shows, in brief, the results:

Time.	Monument.	Signal Office.	Difference.	Time.	Monument.	Signal Office.	Difference.
1887.	*Volts.*	*Volts.*	*Volts.*	1887.	*Volts.*	*Volts.*	*Volts.*
Feb. 9, 11.30 a. m.	1525	66	1459	Feb. 9, 2.15 p. m.	1725	102	1623
11.35 a. m.	1500	.....	.....	2.20 p. m.	1750	78	1672
11.40 a. m.	1375	.....	.....	2.25 p. m.	1600	90	1510
11.45 a. m.	1600	96	1504	2.30 p. m.	1875	66	1809
11.50 a. m.	1675	90	1585	2.35 p. m.	1750	90	1660
11.55 a. m.	1625	84	1541	2.40 p. m.	1825	78	1747
12 m.	1700	90	1610	2.45 p. m.	1750	72	1678
12.03 p. m.	1750	102	1648	2.50 p. m.	1600	84	1516
12.04 p. m.	1800	102	1698	3 p. m.	1950	90	1860
12.05 p. m.	1800	96	1704	Feb. 11, 11.30 a. m.	+250	84	.....
12.06 p. m.	1750	96	1654		−250		
12.07 p. m.	1750	102	1648	11.35 a. m.	+375	.....	.....
12.08 p. m.	1800	96	1704		−375		
12.09 p. m.	1800	102	1698	11.45 a. m.	−175	84	259
12.10 p. m.	1800	102	1698	11.50 a. m.	350	78	272
12.11 p. m.	1750	96	1654	11.55 a. m.	300	84	216
12.12 p. m.	1700	90	1610	12 m.	300	78	222
12.13 p. m.	1725	84	1641	12.01 p. m.	200	78	297
12.14 p. m.	1700	84	1616		375		
12.15 p. m.	1825	96	1729	12.02 p. m.	325	72	253
12.22 p. m.	1850	96	1754	12.03 p. m.	375	72	303
12.25 p. m.	1850	90	1760	12.04 p. m.	425	72	353
12.30 p. m.	2050	84	1966	12.05 p. m.	350	72	278
12.35 p. m.	1950	96	1854	12.07 p. m.	375	84	291
12.40 p. m.	1925	102	1823	12.09 p. m.	.....	72	.....
12.45 p. m.	1900	96	1804	12.10 p. m.	350	72	278
12.50 p. m.	2125	102	2023	12.20 p. m.	475	60	415
12.55 p. m.	2200	.....	.....	12.30 p. m.	400	48	352
1 p. m.	1925	84	1741	12.40 p. m.	575	72	503
1.05 p. m.	1875	90	1785	12.45 p. m.	550	72	478
1.10 p. m.	1900	84	1816	12.55 p. m.	575	72	503
1.15 p. m.	2425	96	2329	1 p. m.	600	60	540
1.20 p. m.	2425	90	2335	1.05 p. m.	587	66	521
1.30 p. m.	1725	84	1641	1.10 p. m.	525	72	453
1.35 p. m.	1900	84	1816	1.15 p. m.	600	66	534
1.40 p. m.	2250	90	2160	1.20 p. m.	575	30	545
1.45 p. m.	1750	84	1666	1.25 p. m.	575	36	539
1.50 p. m.	1875	84	1791	1.30 p. m.	525	54	471
2 p. m.	2050	84	1966	1.35 p. m.	575	48	527
2.05 p. m.	1550	72	1478	1.40 p. m.	400	54	346
2.10 p. m.	1625	78	1547	1.45 p. m.	450	54	396

February 9th was a remarkably clear day, following a spell of damp and foggy weather; the wind from the northwest and light, and a few cirro-stratus clouds in the north and northwest. February 11th was a cloudy day, with strong southwesterly winds, with a light rain in the afternoon and change of wind from south to northwest. Of the regular series of observations, negative values were obtained on the 11th, beginning about fifteen minutes in advance of light rain, and varying from positive to negative during the rain; on the 18th, during light rain; on the 20th, very high positive, changing to high negative, during snow; on the 23d, during heavy snow; on the 26th, high negative values, becoming positive, during snow and rain. The dates of negative values are almost identical with the dates of stormy or broken weather. During clear and settled weather positive indications are given, for the most part, increasing with decrease in temperature.

Of the observations made at New Haven, Connecticut, negative values were obtained on the following dates: On February 2d, during heavy snow, 394 volts, turning to positive 402 volts, during continuance of snow; falling to low positive after ending of snow. On February 3d, variable values during rain. On the 7th rain ended at 8.0 a. m., began again at 1.15 p. m., turning to sleet at 3 p. m., and ending at 11 p. m.; the readings at the four observations were, respectively, —3.5 volts, 4.9 volts, 11.4 volts, and —24.8 volts. On the 8th negative values occur during rain; on the 15th, during heavy rain; on the 18th, —91 volts, during snow and light sleet, at 9 a. m., turning to low positive at 11 a. m., the snow ending at 10.45 a. m., becoming high positive at 1 p. m., with the beginning of rain, and turning to negative during the rain. This was the first thunder-storm of the season noted, and the variations in potential at New Haven, from 7.15 p. m., are shown graphically on chart vi. The times of the different lightning flashes were 7.14 30 p. m., 7.16 20, 7.18, 7.19 30, 7.24 30, 7.26 26, 7.28, 7.31 30, 7.35 40, 7.37 35, then an apparent cessation for about twenty minutes, after which thunder and lightning occur as follows, the last lightning noted above being recorded as near:

Time.	Potential.	Weather.	Time.	Potential.	Weather.
P. M.	*Volts.*		*P. M.*	*Volts.*	
7.40	+150	Rain increasing.	8.33 30	−250	
7.40 30	+200		8.34	−180	
7.41	+350		8.35	−100	
7.41 30	+300		8.36 25	−100	Lightning.
7.42	+250	Light rain.	8.36 30	−250	
7.42 30	+ 90		8.37	−200	
7.43	+ 55		8.38	−205	Lightning.
7.43 30	+ 20		8.38 30	−450	Rain increasing.
7.44	− 30		8.39	+ 40	
7.44 30	− 90		8.40	+ 70	
7.45	−130		8.40 30	−140	Thunder.
7.45 30	−160		8.41	+ 75	
7.46	−180		8.41 30	+400	Lightning.
7.46 30	−200		8.42	+140	
7.47	−220	Light rain.	8.44	+500	
7.48	−240		8.45	+400	Vivid lightning.
7.49	−230		8.45 30	−150	
7.50	−230		8.46	0	
7.51	−225		8.46 30	+450	
7.52	−220		8.47 15	+500	Vivid lightning.
7 57	−100	Light rain.	8.47 30	+ 50	
7.58	+ 40		8.48	+250	
8	+165		8.49	+440	Rain increasing.
8.02	+147	Light rain.	8.49 10	.....	Vivid lightning.
8.03	+130	Thunder.	8.49 30	− 75	
8.04	+185		8.50	− 75	
8.04 30	+250		8.51	+ 50	
8.05	+150		8.52	+400	Vivid lightning.
8.05 30	0	(?)	8.52 15	−130	
8.06	−150		8.53	+100	
8.07	−400		8.54	+600	
8.08	−688	Lightning.	8.55	+560	
8.08 30	−500		8.55 40	+400	Vivid lightning.
8.09	+300	Rain increasing.	8.56	−120	
8.09 30	+450	Lightning.	8.57	−175	
8.10	− 50		8 58	−200	
8.10 30	−200	Rain increasing.	9	−230	
8.11	−300	Lightning.	9 01	+500	
8.12	+550		9.02	+580	
8.12 30	+470		9.02 20	+450	Lightning.
8.13	+410		9.03	−500	
8.13 30	+150	Thunder.	9.03 20	−750	Vivid lightning.
8.14	−150	Lightning.	9.04	−370	
8.14 30	−450		9.05	−480	
8.15	−500	Thunder.	9.06	−400	
8.15 30	−370		9.07	−750	
8.16	−300		9.08	−670	
8.17	− 60	Lightning.	9.09	−540	
8.17 30	+150		9.10	−400	
8.18	+300		9.11	+600	Thunder.
8.19	+250		9.12	+520	
8.20	+ 50		9.12 40	.....	Lightning.
8.20 30	−200	Thunder.	9.13	+200	
8.21	−500		9.14	+260	
8.22	−360		9.15	+230	
8.23	+400	Lightning.	9.16	−100	Light rain.
8.23 30	+500		9.17	−580	
8.24	+470		9.18	−450	
8.25	+400		9.19	−150	
8.26	+350		9.20	+250	
8.27	+250		9.21	+450	
8.28	+ 50		9.22	+150	
8.30	+ 60		9.23	+125	
8.32	+180		9.24	+ 90	
8.33	+300	Vivid lightning.	9.25	+100	

An investigation of this table will show that this winter thunder-storm presented, as regards the electrical conditions, the same general features as the storms of the previous summer. Among many other points, we may notice briefly the rapidly fluctuating character of the curve; the disturbances in the potential, due to the inductive action of the clouds, the values increasing with the cloud's approach and decreasing with its passage; the character of these fluctuations, compared with those due to other causes, being marked by a steadiness of movement in one or the other direction; the rapid changes in value, immediately after, or simultaneous with, flashes of lightning; and, finally, the fluctuations due to rain drops. With regard to the lightning, it would seem that certain discharges occur, which, while not seen, are indicated by the electrometer. For a short time immediately preceding a flash of lightning there occurs a quick, steady rise in the potential, until the electrical tension becomes so great that a disruptive discharge occurs. (It might, incidently, be remarked that, according to Thomson, air at ordinary pressure and temperature can support an electric tension of 9,600 grains weight per square foot before a spark passes.) With the passage of the spark the electric tension ceases and equilibrium is restored. With every flash of lightning the potential immediately falls to zero, to begin slowly to increase, then more rapidly, until the disruptive discharge again occurs. From all this it must be seen that in the electrometer we have but the first application of certain principles in electricity, which can be made of practical service in warning us of the probability of lightning strokes, as well as the advent of the storm.

Other negative values occurred at New Haven on the 22d, with the change of snow into rain, while heavy snow was accompanied with positive values on the 2d, 22d, and 26th.

At Boston, Massachusetts, during the month of February, 1887, negative values occurred on the 6th, at 9 a. m., preceding light rain; on the 10th, preceding threatening weather; on the 11th, preceding rain; on the 18th, at 2.15 p. m., during heavy snow; on the 19th, at 9 a. m., preceding clearing weather, and on the 26th, preceding snow. Snow with positive values occurred on the 1st, 2d, 3d, 18th, 23d, 25th, and 27th. The highest positive potentials occur during clear, cold weather.

At Ithaca, New York, during heavy snow at 9 a. m. of the 1st, high positive values were obtained; on the 2d, during snow throughout the day, the values at the different observations were 1,300, —150, —600, —420 volts. On the 3d rain began at 9.00 a. m., and ended at 2.30 p. m., accompanied by negative values, changing to positive after the ending of the rain; on the 4th low positive during light snow, turning to negative. Snow began on the 7th at 10 a. m., turning to rain at 11.30 a. m., with the following values, —177, —1,215, —308, —205. Negative values occur also on the 8th, during cloudy weather; on the 9th, during fair weather; on the 11th, during fog and rain; on the 12th, preceding and during, snow; on the 13th and 14th, during fine weather; on the 15th, during cloudy weather; on the 17th, during cloudy and clear weather, but preceding snow; on the 19th, preceding, and during, snow; on the 20th, during cloudy weather; on the 21st, during threatening weather, and preceding snow; on the 22d, following snow; and on the 25th, during clear weather, but preceding snow.

ELECTRICAL PHENOMENA.

Fort Maginnis, Montana: cloudy and comparatively warm weather, with light to fresh westerly winds prevailed during the 13th until 2 p. m., when the wind suddenly shifted to northwest and blew a gale of increasing violence until 8.10 p. m., reaching a velocity of eighty-four miles per hour. During the storm the atmosphere was thoroughly charged with electricity, as indicated by the imperfect working of the telegraph instruments.

Dodge City, Kansas: on the 17th high southwest and northwest winds prevailed, blowing down several chimneys and small houses. Light rain fell from 2.10 to 2.25 p. m. The observer at this station states that while the gale was at its height the air was highly charged with electricity, so much so that the battery at Dodge City being disconnected and the wire grounded at Ashland, a town about fifty miles distant, messages were sent between the two points. The observer also at Fort Supply, Indian Territory, states that on the 17th the telegraph instruments worked very badly on account of atmospheric electricity, and during the afternoon he was unable to raise any station except Fort Elliott, Texas. Heavy westerly wind and cloudy weather prevailed.

OPTICAL PHENOMENA.

SOLAR HALOS.

Solar halos were observed at stations in Montana, Dakota, and the Missouri Valley on the 2d. On the 3d and 4th they were reported from a number of stations in the central valleys, the Lake region, and New England. The storm that prevailed over the northeastern quarter of the country on the 11th was preceded on the 9th in the Missouri and upper Mississippi valleys and on the 10th in New England and the Lake region, by solar halos, and was accompanied on the 11th by halos in the Lake region and upper Mississippi valley. From the 12th to the 18th a few halos were reported from widely separated stations. The low area which prevailed over the Lake region and upper Mississippi valley on the morning of the 18th was accompanied and succeeded by solar halos; they were reported from a number of stations in the upper Mississippi valley on the 18th, and from stations in the Gulf States, Mississippi Valley, and Lake region on the 19th. Solar halos were observed at numerous places in New England and the Lake region on the 20th and 23d. The storm that prevailed on the 25th and 26th was preceded on the morning of the 25th by solar halos which were reported from a large number of stations in New England, the Lake region, and upper Mississippi valley.

LUNAR HALOS.

Lunar halos were noted at numerous stations from the 2d to 9th. On the 3d they were observed in the Lake region and at nearly every station in the Missouri and upper Mississippi valleys; in these districts very high pressure and low temperatures prevailed at the time; they were also reported on that date from a few stations in the Ohio Valley, Tennessee, California, and from numerous stations in Arizona. On the 4th a large number of stations in New England, the middle Atlantic states, Ohio Valley, and Lake region reported lunar halos; these were also accompanied or followed by very high pressure and low temperature. On the 28th they were reported from a number of stations in the upper Mississippi valley, the Lake region, and the middle Atlantic states.

The phases of the moon (Washington mean time) during February, as given in "The American Ephemeris and Nautical Almanac" for 1887, are as follows: New moon, 22d, 4 h. 32.1 m.; full moon, 7th, 17h. 5.9 m.; last quarter, 14th, 8h. 23.8 m.; perigee, 8th, 19.3 h.; apogee, 24th, 0.9 h.

MIRAGE.

Saint Vincent, Minnesota: during the morning of the 9th a mirage was seen over the prairie to the south of this place. A track of land, ten miles distant and beyond the line of vision, appeared to be raised in the air, sloping toward the north at an angle of about 45°. All objects, such as houses, barns, and trees, were plainly visible.

Webster, Dakota: mirages were seen on the mornings of the 14th, 16th, and 27th; on the 14th the phenomenon occurred before sunrise, apparently bringing the image of distant objects very near.

Willcox, Arizona: the phenomenon of mirage was seen nearly every day of the month.

Mirages were also seen at Parkston, Dakota, on the 5th and 27th; Henry, Dakota, on the 27th, and Marquette, Nebraska, 28th.